

issued in parts, and when complete, will form two volumes, illustrated with engravings.

HERR SCHÖLER, who was sent out by the German African Society, has returned to Zanzibar after founding a station at Kikoma.

THE Italian traveller, Piaggia, returned to Khartum on April 30. It is believed there that he will be appointed governor of the Fashoda district, and that the Austrian, Maruo, will become governor of the province of the Blue Nile.

THE Scientific Commission, recently despatched from Paris, has arrived at Zanzibar on its way to examine M. Paiva's vast concession in the Zambesi region, which it is proposed to develop by means of a company. The Commission is to investigate the resources of the territory, chiefly with regard to the mineral wealth supposed to exist there.

PHYSICAL NOTES

A FEW months ago the phenomenon of the "passive state" of iron was examined by M. L. Varenne, who attributed it to the presence of a film of nitrous acid gas upon the surface of the metal. The question has been recently reinvestigated by M. E. Bibart, who finds reason to doubt M. Varenne's conclusions. M. Bibart states that any oxidising agent aids, and any deoxidising agent hinders, the production of passivity.

IN a long memoir presented to the Académie des Sciences by Edmond and Henri Becquerel some very valuable data are given respecting the fluctuations of underground temperatures during 1880 beneath different surfaces. Their observations extended to a depth of 36 metres. The fluctuations were of less extent beneath herbage than below a bare soil, the maxima and minima being more retarded and of less amplitude in the former case. Another interesting point is the protecting effect of a bed of snow. Though the temperature of the air fell to -15° , and continued below 0° for long periods, that of the surface of the soil was rarely below -1° , never below $-1^{\circ}5$.

ACCORDING to Nies and Winkelmann, who have lately studied the expansion exhibited by bismuth, cast-iron, and other metals during their solidification, the specific gravity of bismuth is between 1.031 and 1.0497 times as great in the liquid as in the solid state; a sample whose (solid) density was 10.2 assumed a density of 10.77 when melted. The ratio of the density in liquid state to that in solid state was greater than unity also for the metals tin and zinc, the ratio for tin being 1.0070, and for zinc 1.002. Our readers will doubtless recall the recent experiments of Mr. Wrightson and Prof. Chandler Roberts in the same direction.

HERR STUCKER concludes from experimental inquiry (*Wied. Ann.* No. 5), that the gases chlorine, bromine, and iodine, in regard to thermal behaviour, form a group by themselves among biatomic gases. The ratio of the kinetic energy of the progressive motion of the molecules to the total energy is different for them from that for the others. In their molecules the atoms seem to have a different reciprocal action. From the behaviour of biatomic gases it is inferred that neither Boltzmann's nor Maxwell's supposition as to the nature of the mobility of atoms in the gaseous molecule has a general validity.

WITH regard to the subject of hot ice, Herr Wüllner describes fresh experiments (*Wied. Ann.* No. 5), and he finds that so long as the thermometer-bulb is wholly surrounded with dry ice its temperature does not reach 0° . If the thermometer rises higher, either the bulb is no longer quite covered with ice, or it is surrounded with water, along with a thicker ice-layer. The author's method was to have the thermometer-bulb first coated with ice in a separate vessel; then introduced into the heating-tube and fixed in a caoutchouc stopper; this tube is connected through a tube and spherical vessel with the air-pump, and with the sphere is surrounded with a cold mixture while the vacuum is produced.

THE subject of double refraction of light in moving frictional liquids has been taken up anew by Herr Kundt (*Wied. Ann.* No. 5), using a method which Maxwell did not succeed with, viz., rotation of a cylinder within another cylinder, and sending a beam of polarised light in axial direction through liquid in the annular space. Herr Kundt got positive results in this way with various liquids. 1. The amount of internal friction of liquids is not a certain measurement of the occurrence of double refraction in

motion; liquids with small friction giving considerable refraction, and *vice versa*. 2. The liquids which, with small internal friction, prove doubly refractive, belong to the so-called colloids (gelatine, gum, collodion) or the oils. Solutions of crystalloids did not give the phenomenon by the method described. 3. The double refraction did not markedly affect the rotation of the plane of polarisation in the circularly polarising liquids (but the strongest refraction, it is to be noted, produced a difference of only about half a wave in penetrating a pretty long column of liquid). 4. In collodion-solutions the axes of the double refraction do not lie in the azimuths required by theory. The anomaly was not accounted for. Herr Kundt further offers some general remarks on the relations between the elastic properties of liquids, their coefficients of friction, and the double refraction developed in them.

It has been hitherto supposed that light directly reflected from a diffraction-grating has the same state of polarisation as light passing through the same plate unruled, or reflected from its smooth surface. Herr Fröhlich now finds, with a very finely-ruled grating, that it is not so. The proof and numerical amount of the difference are indicated in *Wied. Ann.* No. 5.

IN the cold of last winter M. Damien (*Journ. de Phys.*, May) investigated the indices of refraction of water under 0° (i.e. in surfusion) down to -8° . He measured the indices corresponding to the three hydrogen lines by the prism method. Starting with a temperature of $+20^{\circ}$, he first confirmed M. Jamin's observation that the passage through the maximum of density does not at all disturb the course of the indices, and he further found that the indices continue to increase below zero, though the density diminishes. The variations of the indices are very small. M. Damien hopes, next winter, to apply the interferential method. (The use of freezing mixtures does not present such favourable conditions as the very slow cooling of the atmosphere.)

RECENT researches by Herren Sohncke and Wangerin on Newton's rings (*Wied. Ann.* Nos. 3 and 4) appear to require a considerable change of ideas as to this phenomenon, and more especially as to the place where interference occurs. The starting-point was an experiment in which the rings produced by a beam of parallel sodium light falling at an angle on a horizontal plate above a plane convex lens were examined with a microscope inclined at the same angle, and capable of being moved horizontally as well as in the direction of its axis. The microscope was first so placed that one part of a dark ring was as sharply defined as possible; the instrument being then moved along to another ring, or another part of the same ring, it was found necessary to move it axially, higher or lower, to get the maximum definition for that part; indicating that the rings do not lie in a horizontal plane, but in some other position. The amounts of axial displacement for different parts of the ring-system were carefully noted. For details of the results we must refer to the original, merely noting, *inter alia*, that the places of interference in the plane of incidence going through the centre of the rings seem to lie in a straight line rising towards the side whence the light comes. In a central plane at right angles to that of incidence, all the places are at the same depth. Herr Sohncke undertook the experimental part in this investigation, while Herr Wangerin has worked out the theory of the phenomena.

ACCORDING to experiments by Herr Kundt (*Wied. Ann.* No. 4), the common surface-tension between liquid and gas decreases considerably with increasing pressure of gas in the case of alcohol, ether, alcoholic solution of calcium-chloride, sulphide of carbon, chloroform, and water. The decrease is greater at low pressures than at high. For a given liquid it varies with the nature of the gas compressed. With alcohol, ether, and alcoholic chloride of calcium solution, air causes a greater decrease of the capillary constant than hydrogen. The decrease is so great with some liquids (e.g. ether in air) that probably, with pressures reached without much difficulty, the surface-tension is *nil*, the liquid passing at ordinary temperature into the Cagniard de la Tour state. (The author's experiments were concluded before he knew of Caillaud's experiment, in which a mixture of five vols. of CO_2 and one vol. of air is compressed at a low temperature till the meniscus of CO_2 disappears, and the Cagniard de la Tour state is reached.)

THE ratio of intensity of the two sodium lines has been estimated by Herr Dietrich (*Wied. Ann.* No. 4) using apparatus of great dispersion with a Viorordt double slit giving one spectrum above another, and allowing of displacement, so that one

of the two lines in one spectrum is brought directly over the other in the other spectrum. The photometric parts included a Nicol capable of rotation, a right and left rotating double quartz, and a fixed Nicol. The mean value of the ratio sought, from measurements on three days, was 1.60 ± 0.01 ; the probable error of an observation being ± 0.032 .

THE amount of electric expansion in caoutchouc has been investigated by Herren Korteweg and Julius (*Wied. Ann.* No. 4). They used tubes of white vulcanised caoutchouc made insulating in water by being kept twenty-four hours in oil; the tube was filled with water and placed in a water-bath (to form a condenser), while hydrostatic pressure was varied, and the changes of volume were measured by means of a connected tube-system. The change of volume is shown to be proportional to the square of the striking distance, and inversely proportional to the square of the thickness of tube-wall. It is the same whether the inner liquid be charged negatively or positively. The maximum was reached when the Holtz machine, left to itself, gradually slackened speed till the last spark passed. A table, giving also Quincke's data for glass, shows that both for this and for caoutchouc the volume-changes are, roughly speaking, in inverse ratio of the coefficients of elasticity, so that they must be ascribed to the same cause.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—During the Long Vacation there will be a course of lectures in the University Laboratory by Mr. Fenton, one of the Demonstrators, on Organic Chemistry. The Laboratory will be open for practical work.

During the Michaelmas Term there will be twelve courses of lectures on Chemistry and various branches of Physics, including one by Mr. Shaw on the Conservation of Energy and Theory of Unitation, and a course by Prof. Lewis on the more Common Mineral Rock-Constituents, and another on Descriptive Crystallography by the same.

Prof. Dewar's subject will be Physical Chemistry; and among other advanced lectures will be a course on the General Principles of Chemistry by Mr. Pattison-Muir.

Prof. Hughes and Mr. Tawney will divide between them the work in Geology, Mr. Tawney taking Palæontology in the Michaelmas Term.

Lectures on Botany will be given by Messrs. J. W. Hicks, Vines, Saunders, and Hillhouse. Dr. Vines' lectures in the Michaelmas Term will be on the Physiology of Plants, with practical work, at Christ's College.

Prof. Newton and the Demonstrator of Comparative Anatomy, Dr. Michael Foster, and his corps of lecturers, Prof. Humphry, Mr. Creighton, and Mr. Balfour, will give their usual series of lectures and demonstrations during the Michaelmas Term. Mr. Lea will give advanced lectures on Digestion and Chemical Physiology, and Mr. Langley will lecture on the Histology and Physiology of Muscle, Nerve and the Nervous System.

Dr. Bradbury will lecture on Pathological Anatomy, Prof. Latham on General Therapeutics, Prof. Paget on Clinical Medicine, and Mr. Carver on Clinical Surgery.

The Natural Sciences Tripos, Part I., under the Old Regulations, has just been completed, and the pass-list contains the names of thirty-three men, and three are excused the General Examination. The second part of this examination takes place in December.

The first part of the examination under the New Regulations, by which men can enter for the examination in their second year if they prefer, has just resulted in the publication of a list with five names, in alphabetical order, in the first division, viz. Messrs. Daniels (Trinity), Duncan (Caius), Earl (Christ's), Sherrington (Caius), and Wilberforce (Trinity).

The special examinations in Natural Science for the ordinary B.A. degree have yielded seven men in the first class in Chemistry, and eighteen in the second class. In Geology there was but one man in the first and one in the second class; in Botany, one in the first class; in Zoology, one in the second class.

At Trinity College the prizemen in the June examination in Natural Science were: Third year, Hillier and Ritchie; second year, Daniels and Wilberforce; first year, Davis, Head, Ransom, Thompson. The prizemen at Christ's College are Shipley (first year), Earl (second year), and Parkyn (third year).

The Chancellor of the University (the Duke of Devonshire)

has (with the concurrence of Earl Cairns, Chancellor of the University of Dublin) declared that the statutes of Cambridge do not preclude the University from using the Previous and the Tripos Examinations for the purpose of testing the proficiency of women, as sanctioned by the Senate on February 24, 1881.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, May 19.—"Molecular Magnetism," by Prof. D. E. Hughes, F.R.S.

1. *Influence of an Elastic Torsion upon a Magnetic or an Electric Conducting Wire.*—In my paper of March 7th on "Molecular Electro-Magnetic Induction," I showed that induced currents of electricity would be induced in an iron wire placed on the axis of a coil through which intermittent currents were passing, and that these currents were produced only when the wire was under the influence of a torsion not passing its limit of elasticity. It became evident that if the intermittent magnetism induced by the coil produced under torsion intermittent currents of electricity, an intermittent torsion under the influence of a constant current of electricity or a constant magnetic field would produce similar currents. This was found to be the case, and as some new phenomena presented themselves indicating clearly the molecular nature of the actions, I will describe a few of them directly relating to the subject of this paper.

The apparatus used was similar to that described in my paper of March 7th. An iron wire of 20 centims. was placed in the centre or axis of a coil of silk-covered copper wire, the exterior diameter of the coil being $5\frac{1}{2}$ centims., having an interior vacant circular space of $3\frac{1}{2}$ centims. The iron wire is fastened to a support at one end, the other passing through a guide, to keep it parallel but free, so that any required torsion may be given to the wire by means of a connecting arm or index. A sensitive telephone is in direct communication with the coil, or a galvanometer may be used as the currents obtained by a slow elastic torsion are slow and strong enough to be seen on a very ordinary galvanometer. I prefer, however, the telephone, because it has the inestimable advantage in these experiments of giving the exact time of the commencement or finish of an electric current. It has, however, the disadvantage of not indicating the force or direction of the current; but by means of the sonometer the true value and direction of any current is at once given. The current from a battery of two bichromate cells is sent constantly through the wire if we wish to observe the influence of the torsion of the wire upon the electric current, or a constant field of magnetic energy is given to the wire by either a separate coil or a permanent magnet. The currents obtained in the coil are induced from the change in the molecular magnetism of the wire, but we may equally obtain these currents on the wire itself without any coil by joining the telephone and rheotome direct to the wire; in the latter case it is preferable to join the wire to the primary of a small induction coil, and the telephone and rheotome upon the secondary, as then the rheotome does not interrupt the constant electric current passing through the wire. As the results are identical, I prefer to place the telephone on the coil first named, as the tones are louder and entirely free from errors of experimentation.

If we place a copper wire in the axis of the coil we produce no effect by torsion, either when under the influence of a constant magnetic field or a current passing through it, nor do we perceive any effects if we place an iron wire (2 millims. in diameter), entirely free from magnetism, and through which an electric current has never passed. I mention this negative experiment in order to prove that all the effects I shall mention are obtained only through the magnetism of the wire. If now I pass an electric current for an instant through this same wire, its molecules are instantly polarised, and I have never yet been able to restore the wire to its original condition, and the magnetisation induced by the passage of a current is far more powerful and more persistent in soft iron than tempered steel. This may be due, however, to the fact that in tempered or softened steel we find traces only of a current during the rotation by torsion of its molecules some two to three degrees of sonometer, whilst iron gives constantly a current of 70 sonometric degrees.¹

In order to obtain these currents, we must give a slight torsion of 5° or 10° to and fro between its zero point. We then have a current during the motion of the index to the right, and a contrary current in moving the index to the left. If we use a

¹ 0.8 of a Daniell battery.